

Work, Energy and Power (chapter 6)

Work

Think of a scenario:

4 students

- 1- Holding a pile of books
- 2- lifting a piece of paper
- 3- waiter carrying a tray of food horizontally
- 4- lifting the paper diagonally

Who does more work?

1 is exerting the greatest force

1 and 3 are not changing gravitational potential energy or kinetic energy.

They are also not applying the force in the direction of motion.

Definitions of Work:

Work is a change in energy. - general

$$W = \Delta \text{Energy}$$

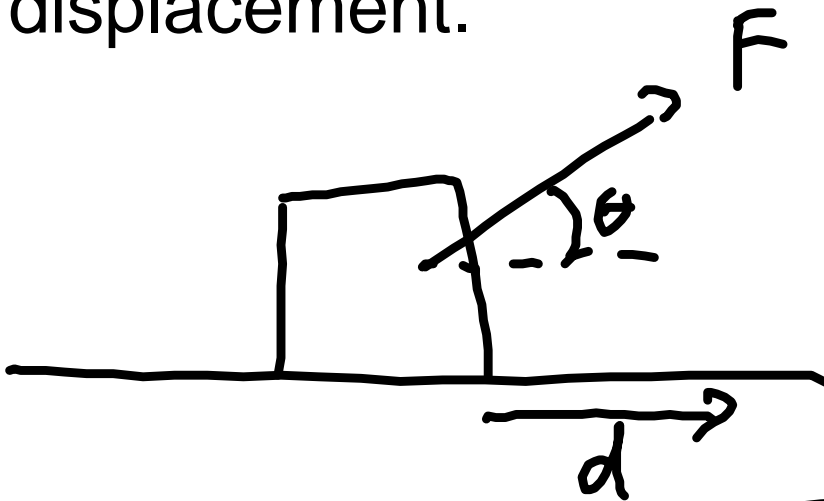
the problem with this definition is the question, what is energy?

energy is the ability to do work. A conserved quantity.

The other definition:

Work is the vector dot product of force and displacement.

The work done is the product of the component of force in the direction of displacement.



$$W = F \cdot d = Fd \cos \theta$$

where θ is the angle

between F and d .

if Force is constant then we use

$$W = Fd \cos \theta$$

but if F changes (jerky on accelerator in a car, roller coaster with gravity changing direction, rockets with fuel changing the mass, use change in energy to solve problems)

uniformly changing force

eg. springs or universal gravitation

then use the area under the F - d graph for calculating the work done

(watch out! area under F - t graph is impulse, change in momentum)

eg.

1. You pull a 45kg bale of hay with 450N of force at 28° to the horizontal over 4.0 m. If the force of friction is 250N

determine work done by:

- a) you
- b) friction
- c) net force
- d) normal force
- e) gravity

2. A spring has a length of 20.0 cm when not extended. If you hang a 500g mass on it, it extends to 32.0cm.

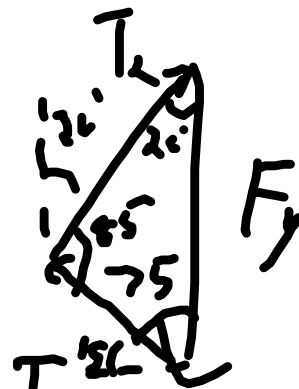
a) what is the elastic constant, k?

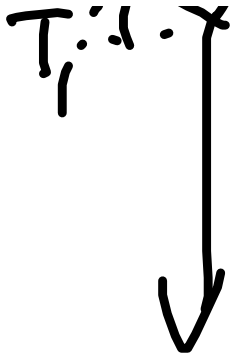
$$F_{\text{elastic}} = -kx$$

b) graph F_{elastic} vs x

c) how much work is done pulling the 500g mass down another 10.0 cm ($L = 42.0\text{cm}$)

d) if you let go at c, what is the acceleration of the 500g mass?





$$\frac{\sin 85}{F_y} = \frac{\sin 25}{T_2}$$

$$T_1 \cos 15 = T_2 \sin 20$$

$$T_1 \sin 15 + T_2 \cos 20 = F_y$$

p144 Q5,7,13